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important forms of quadric surfaces and the equations of a space curve. The statement that the polar coördinates of a point in space are ρ, α, β and γ (ρ being the radius vector and α, β and γ the direction angles) is not in accordance with the usual notation for polar coördinates. Moreover the use of four coördinates for a point in some cases and three in others is confusing to the student, even though he is told that the four are not independent.

The problems in the book are almost entirely from the field of pure mathematics, few from engineering or other sources being used. The answers are given for most of the problems, either immediately after the statement of the problem or in a list of answers at the end of the book. Sets of miscellaneous examples inserted from time to time furnish an opportunity for review.

As already indicated in quotations from the preface, the book is conveniently arranged for use either in a course for a term, a semester or a year. The traditional over emphasis on conic sections is relieved by the excellent chapters on polar coördinates, transcendental equations and parametric equations.

CLINTON H. CURRIER.

PROVIDENCE, R. I.,
March 1, 1919.

Lezioni sulla teoria dei gruppi continui finiti di transformazioni. By L. BIANCHI. Pisa, E. Spoerri, 1918. 8vo. 6 + 590 pp. Price 25 lire.

This volume was written for the students of the Italian universities and is a reproduction, with few changes, of the course by the same author which appeared in lithographed form about fifteen years ago. It constitutes the second introductory treatise on continuous groups in the Italian language, an earlier one having been published by G. Vivanti under the title *Teoria dei gruppi di transformazioni,* 1898; translated into French by A. Boulanger, 1904.

The interest of Italian mathematicians in the general field of group theory is reflected by the fact that they have now in their own language at least five books on this subject. Two of these relate to finite groups, viz., the translation into Italian of Netto's *Substitutionentheorie* by G. Battaglini, 1885, and the excellent introduction entitled *Lezioni sulla teoria dei gruppi di sostituzioni,* 1910, by the author of the work now under review. Their other books on group theory are devoted to the groups of analysis and geometry, and include the well-known *Teoria dei gruppi discontinui e delle funzioni automorfe* by G. Fubini, 1908, in addition to the two works mentioned in the preceding paragraph.

L. Bianchi is well known to American mathematicians as the author of good books relating to each of the three great fields of mathematics—algebra, analysis and geometry. His wide range of mathematical knowledge and his extensive experience as a writer have qualified him admirably for the production of a work having such varied contact as a treatise on continuous groups should exhibit. In the present work he has restricted himself largely to a lucid exposition of the theories contained in the first volume of the *Theorie der Transformationsgruppen* by Lie-Engel, 1888–1893.

The book is divided into thirteen chapters. The first of these is devoted to a brief exposition of auxiliary theories relating mainly to systems of differential equations. In chapters II to XI inclusive there is given a very clear exposition of the fundamental concepts of continuous groups, exclusive of the important theory of contact transformations. The last two chapters are devoted to applications. In the former of these, Chapter XII, the author gives the fundamental concepts relating to the applications of the theory of continuous groups in the theory of differential equations. The final chapter is devoted to geometric applications and bears the heading "Applicazioni alla teoria degli spazi pluridimensionali con gruppi continui di movimenti."

Although the present work is considerably more concise than the *Vorlesungen über Continuierliche Gruppen,* 1893, by Lie-Scheffers it is almost equally elementary and leads the student much more rapidly to the fundamental theorems of the subject. The book is unusually free from errors and constitutes a decidedly useful aid for acquiring quickly an insight into the abstract theory of finite continuous groups. While the founder of the theory of continuous groups was a Norwegian he published most of his extensive systematic developments in the German language, and the present work will be especially welcomed by those who desire to acquire a knowledge of this field but do not read German comfortably.

G. A. MILLER.

An Introductory Treatise on Dynamical Astronomy. By H. C. PLUMMER. Cambridge: at the University Press, 1918. Royal 8vo. 19 + 343 pp. Price 18 shillings.

Contents—Chapter I: The law of gravitation, 1–10; II: Introductory propositions, 11–20; III: Motion under a central attraction, 21–32; IV: Expansions in elliptic motion, 33–48; V: Relations between two or more positions in an orbit and the time, 49–64; VI: The orbit in space, 65–72; VII: Conditions for the determination of an elliptic orbit, 73–84; VIII: Determination of an orbit, Method of Gauss, 85–93; IX: Determination of parabolic and circular orbits, 94–102; X: Orbits of double stars, 103–114; XI: Orbits of spectroscopic binaries, 115–128; XII: Dynamical principles, 129–141; XIII: Variation of elements, 142–157; XIV: The disturbing function, 158–176; XV: Absolute perturbations, 177–191; XVI: Secular perturbations, 192–206; XVII: Secular inequalities, Method of Gauss, 207–217; XVIII: Special perturbations, 218–235; XIX: The restricted problem of three bodies, 236–253; XX–XXI: Lunar theory, 254–291; XXII: Precession, nutation and time, 292–311; XXIII: Libration of the moon, 312–322; XXIV: Formulæ of numerical calculation, 323–340; Index, 341–343.

Quotations from the preface: "This book is intended to provide an introduction to those parts of Astronomy which require dynamical treatment. To cover the whole of this wide subject, even in a preliminary way, within the limits of a single volume of moderate size would be manifestly impossible. Thus the treatment of bodies of definite shape and of deformable bodies is entirely excluded, and hence no reference will be found to problems of geodesy or the many aspects of tidal theory. Already the study of stellar motions is bringing the methods of statistical mechanics into use for astronomical purposes, but this development is both too recent and too distinct in its subject-matter to find a place here. . . . Since the main object in view has been to cover a wide extent of ground in a tolerably adequate way rather than to delay over critical details, the absence of mathematical rigour may sometimes be noticed. Very little attention is given to such questions as the convergence of series. It is not to be inferred that these points are unimportant or that the modern astronomer can afford to disregard them. But apart from a few simple cases where the reader will either be able to supply what is necessary for himself, or would not benefit even if a critical discussion were added, such questions are extremely